A LACUSTRINE SHARK FROM THE LATE PERMIAN OF BLACKWATER, CENTRAL QUEENSLAND

Extended Abstract

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The Rangal Coal Measures in the Utah Development Company's open-cut coal mine, 20 km SSW of Blackwater, central Queensland, contain several mass-mortality horizons that have yielded a bobasatraniform (Campbell and Duy Phuoc 1983), at least twelve new genera of Palaeonisciformes, and two new genera of Elasmobranchii. One, a phoebodontiform, was an active cruising shark.

A new elasmobranch from the Late Permian of Queensland (Figs 1A, B), is characterised by a palatoquadrate with well-developed ethmoidal articulation, cladodont (phoebodontiform) dentition, absence of ribs, a non-lunate caudal fin, and dorsal finspines with an anterior keel and a flat to concave posterior wall whose postero-lateral margins bear three transverse rows of barb-like denticles (Fig. 2). The new form is known from three articulated specimens, the largest being 19.3 cm in length; a single finspine, 6-6.5 cm in length, indicates that these sharks may have attained lengths of between 50-75 cm.

The following interpretation of the functional morphology of the new form is based on studies of body shape and locomotion in sharks, (Thomson, 1976; Thomson & Simanek, 1977) specifically the mechanical action of the heterocercal tail.

The caudal fin of the new shark has a heterocercal angle between 17-25°, a dorsal thrust angle (Thomson & Simanek, 1977, p. 346) between 7.5-10°, a large epicaudal lobe, a sub-terminal lobe and a ventral hypochordal lobe. The moderate heterocercal angle of the tail indicates that the shark would have been capable of producing relatively powerful turning moments about the centre of balance, enabling it to change direction rapidly and efficiently. Thomson (1976) determined that sharks possessing a well-developed epicaudal lobe and low to intermediate dorsal thrust angles (intermediate angles range from 10-25°) are characterised by slow cruising speeds. At high speeds, such sharks would not be capable of maintaining in balance the various thrusts produced by the respective fin lobes. In summary, the new form, when active, would have been capable of high manoeuverability, slow cruising speeds and incapable of sustaining high speeds.

The non-lunate caudal fin is a character that Compagno (1977) and Young (1982, character 10) regard as synapomorphic for *Tristychius, Onychoselache, Hybodus, Palaeospinax* and Recent euselachians. Thomson and Simanek (1977) noted that the morphologies of neoselachian caudal fins, whether lunate or non-lunate, do not equate with current shark systematics. They concluded that the various tail patterns have been convergently derived and are related to different modes of life. Ctenacanthiform sharks probably possessed a variety of caudal fin architectures as functional adaptations for specific life habits. Due to the possibility of convergence, the non-lunate caudal fin of hybodonts, ctenacanths (*Bandringa*), and neoselachians cannot be construed as synapomorphic, regardless of whether the morphotypic condition was deeply forked and almost equilobate. Maisey's amendment to this character (Maisey, 1984, character 35, hypaxial endoskeleton of tail reduced) is consistent with the record. Further comparative study of the caudal endoskeleton of Recent sharks is required to ascertain if the primitive state can be convergently derived, as in the case of plesodic pectoral fins (Maisey, 1984, p. 366).

The following finspine characteristics of euselachians are widely shared amongst groups (Rieppel, 1982) such as xenacanths, ctenacanths, hybodonts and neoselachians: concave posterior wall, posterolaterally-situated denticles and posteriorly-placed central cavity. I concur with Dick (1978, p. 107) and Young (1982, p. 838) that the similarities between ctenacanth and neoselachian finspines are symplesiomorphies.

Maisey (1984, p. 365) considered that xenacanths were a specialised group of ctenacanthiform sharks because both possess dorsal finspines with a pectinate ornament (implying that the two groups, separated during, or prior to, the Middle Devonian) and a broad, expanded occipital segment (Maisey, 1984, characters 18, 19). Pectinate ornament of the ctenacanthiform variety may be a plesiomorphic euselachian character or convergently derived. The dimensions of the occipital segment of *Hybodus* resemble closely the xenacanth/Cleveland "*Ctenacanthus*" condition and differ significantly from those of most neoselachians (Leu, 1989). It is more parsimonious to regard a broad, expanded occipital segment as a primitive character shared by xenacanths, ctenacanths and hybodonts. In the absence of other shared characters, the evidence is too tenuous to demonstrate confidently that xenacanths are a specialised group of ctenacanthiform sharks. Even so, I intuitively agree, from a phenetic viewpoint, with Schaeffer's (1981, p. 61) conclusion that the Cleveland *"Ctenacanthus"* represents a sister group to *Xenacanthus, Tamiobatus* and *"Cladodus"*

Comparisons with placoderms and acanthodians suggest that a broad, expanded occipital region may be a primitive gnathostome character. Amongst the arthrodires, the phlyctaeniniids (*Kujdanowiaspis*) and the brachythoracids (*Pholidosteus* and *Tapineosteus*) possess extremely long and broad occipital segments. *Acanthodes* has a broad expanded occipital segment that extends beyond the otic region for 20.5%the total length of the neurocranium.

☐ *Permian, Rangal Coal Measures, Chondrichthyes, Blackwater, Queensland.*

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LITERATURE CITED

CAMPBELL, K.S.W. AND DUY PHUOC, L. 1983. A late Permain actinopterygian fish from Australia. *Palaeontology* **26**: 33–70.

COMPAGNO, L.J.V. 1977. Phyletic relationships of living sharks and rays. *American Zoologist* **17**: 303–22.

DICK, J.R.F. 1978. On the Carboniferous shark *Tristychius arcuatus* Agassiz from Scotland. *Transactions of the Royal Society of Edinburgh* **70**: 63–109.

LEU, M.R. 1989. A Late Permian freshwater shark from eastern Australia. *Palaeontology* **32**: 000–000.

MAISEY, J.G. 1984. Chondrichthyan phylogeny: a look at the evidence. *Journal of Vertebrate Paleontology* **4**: 359–71.

RIEPPEL, O. 1982. A new genus of shark from the Middle Triassic of Monte San Giorgio, Switzerland. *Palaeontology* **25**: 399–412.

SCHAEFFER, B. 1981. The xenacanth shark neurocranium, with comments on elasmobranch monophyly. *Bulletin of the American Museum of Natural History* **169**: 1–66.

THOMSON, K.S. 1976. On the heterocercal tail in sharks. *Palaeobiology* 2: 19–38.

THOMSON, K.S. AND SIMANEK, D.E. 1977. Body form and locomotion in sharks. *American Zoologist* **17**: 343–54.

YOUNG, G.C. 1982. Devonian sharks from south-eastern Australia and Antarctica. *Palaeontology* **25**: 817–43.

A B

FIG. 1A. An articulated specimen (QMF14470A) of the new genus preserved in lateral view, minus the distal portion of the caudal fin, X 1.5. B. An almost complete specimen (AMF72559A) of the new genus in lateral view, X 1. The circular feature is a plugged drill hole. Abbreviations: AMF, Australian Museum Fossil: QMF, Queensland Museum Fossil.

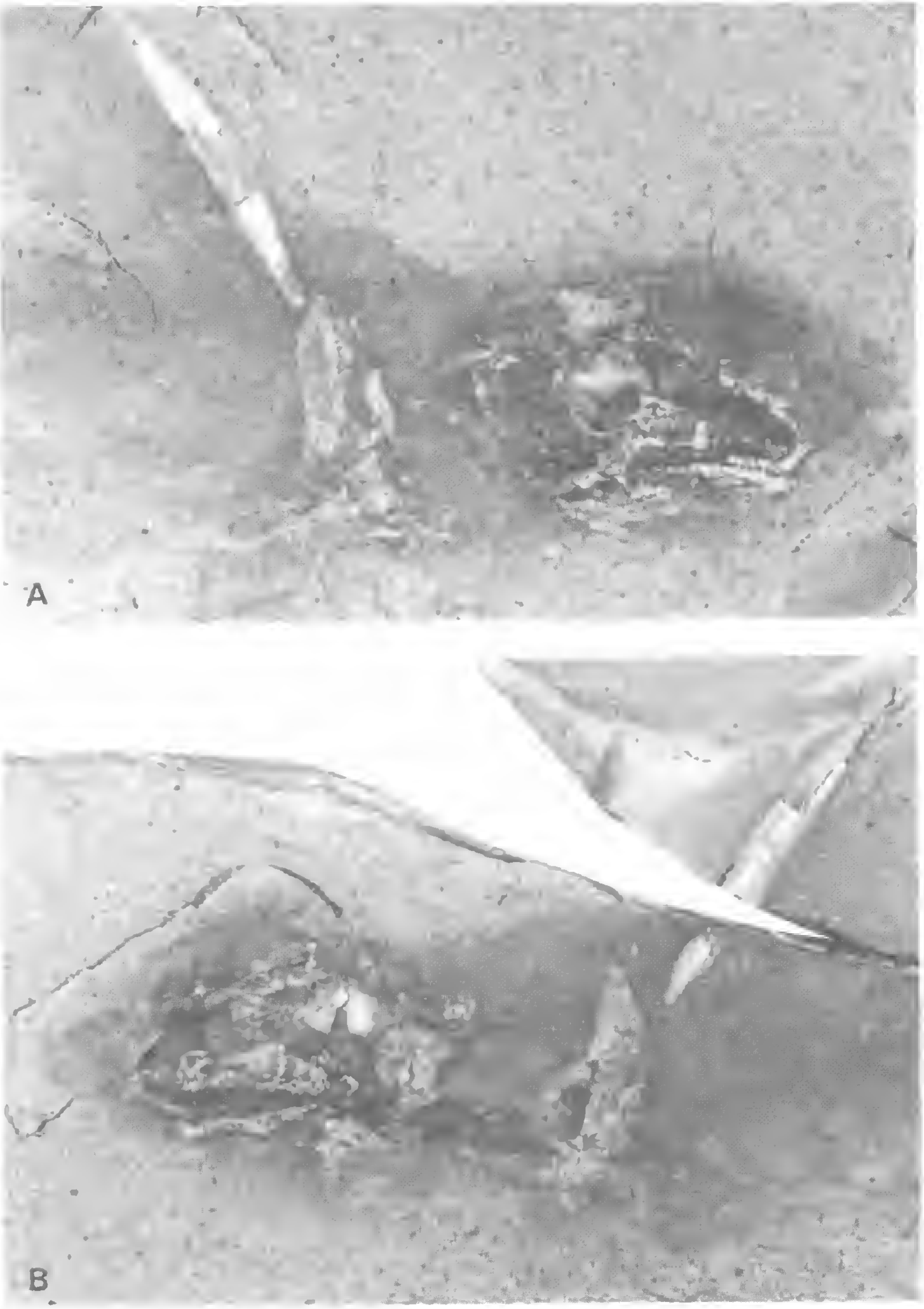

FIG. 2. Details of the head, pectoral girdle and anterior dorsal finspine of (A)QMF14470A (X 2.5) and (B)AMF72559A (X 2.3) respectively.